Modification Of The Cylinder Head Of Performance Motorcycle

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Abstract. Lately, other than as a means of transportation, motorcycles are also used for the competition performance. Methods breathing cylinder head into a simple matter to change the volume of the combustion chamber in order to increase the compression ratio. The method used is the method of experiments conducted in the laboratory. Where use 110cc Honda Beat motorcycle and premium fuels and pertalite, as well as the use of standard and modified cylinder head to determine the impact on its performance. Research carried out by using a dynamometer (dynotest) to determine the maximum power and maximum torque on a motorcycle. The results showed that the cylinder head testing using standard with premium fuel produces maximum power of 4.67 HP at rotation of 6500 rpm and maximum torque of 4.70 ft.lbs round of 4500 rpm, while the power gained 5.24 pertalite HP round 6750 rpm and a torque of 5.19 ft.lbs at 4700 rpm rotation. And testing using a modified cylinder head with premium fuel maximum power obtainable by 5.32 HP and a maximum torque of 4.40 ft.lbs, while pertalite obtained power of 6.34 HP and a torque of 5.17 ft.lbs.Keywords: compression ratio; Cylinder head; Work method.

1. Introduction

1.1Background

The development of science and technology today is very fast, it gives a sign that the advance of human civilization. One of its forms is increasing human activity, it is this which requires scientists to try to createa tool or machine that helps the human performance. Motor vehicles are one means of transportation that require the engine as of the beginning, both for two-wheeled vehicles and four-wheeled vehicles. Motor fuel is one machine that is used as an early mover transportation. Lately, selain as a means of transportation, motorcycles are also used for the competition performance. To produce motorcycles with performance high that can be achieved many ways, ofonethemostimportantisto make modifications to the *engine.*Modifications can be done by making changes to *the cylinder head* to getchanges in the volume of space fuelthat aims to achieve a change in the compression ratio. Changes compression ratio can affect the torque and power in a single-cylinder internal combustion engine.Fuel plays an important role in motor fuel, the calorific value contained therein is a value that states the maximum amount of heat energy liberated by a fuel through the complete combustion reaction of unity mass or volume of such fuel.Therefore it is necessary to investigate the effect of modification *of the cylinder head* of the engine performance single-cylinder motorcycle premium fuel and pertalite which can then be recovered power and maximum torque difference.

1.2Problem Formulation

From the description above background, obtained the principal problems in this study are as follows:

1. How much influence themodifications*cylinder head* to the performance of the bikesingle-cylinder motorcycle.
2. To determine the performance generated by the type of fuel to increase the compression ratio.

2. Theory

Motor fuel is a type of propulsion that is widely used. By utilizing heat energy from combustion into mechanical energy. Motor fuel is one kind of heat engine that processes occurring in the motor fuel combustion itself so that the combustion gases occurring at the same time as working fluid.Motor fuel can be divided into two, namely the internal combustion engine and the external

combustion engine.External combustion engine is a machine where the media or working fluidUtilizingcombustion heat is separated by a dividing wall with the heat of combustion. Which can be classified in this type of machine include closed-cycle gas turbine and steam boiler together with a steam turbine, condenser and pump forming steam energy generation systems.

Combustion engine is the engine that utilizes a working fluid or hot gases of combustion in which the medium that utilizes hot gases of combustion with working fluid are not separated by a dividing wall. Energy conversion engine that can be classified into internal combustion engine is a type of motor gasoline motors, diesel engines, and the open-cycle gas turbines.

2.1 *Otto cycle*

In theOtto cycle or cycles of constant volume combustion process occurs at constant volume, while the otto cycle there are ongoing with four (4) step or two (2) step. For machines 4 (four) working cycle steps take place with four (4) step piston or two (2) of the crankshaft. Thesteps in the cycle otto y aitu piston movement of cusp (TM A = top dead point) to the down position (TM B = bottom dead point) in the cylinder. Theoretical calculation on the ideal cycle would include four process is compression, expansion, heating, and cooling.The following figure Adala h diagram of the pressure-volume (PV) ideal cycle 4 stroke motors fixed volume (s siklu Otto).

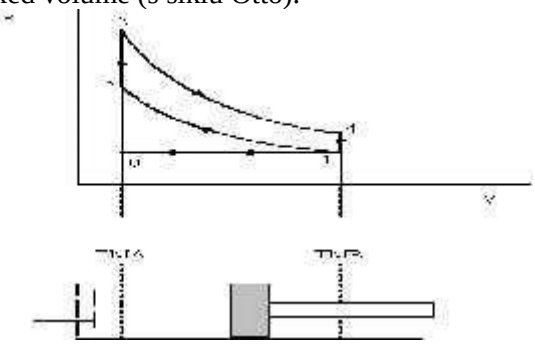

Figure 1. PV diagram in s iklus Otto

Steps 0-1 are the intake stroke, the compression step is a step 1-2, 2-3 line is rapid combustion that generates an heating gas at constant volume, steps 3-4 are pan as gas expansion step , while the 4-1 segment of the pressure drop suddenly because of the opening of the exhaust valve. After the gas discharged in step 1-0.

2.2 Motor Gasoline

Motor gasoline Adala h one menggun motor fuel that will be gasolineas fuel. Gasoline itself is a fuel thatis easy mterbakar and evaporated. Normal combustion velocity ranged between 15-20 m / sec, the air temp eratur increased up to 1500 ° C (1773 K) and the pressure reached kisaaran 30-40 kg / cm^2 (0:03 to 0:04 N / $m^{2)}$.Motor gasoline is also a power generating machine that converts the fuel gas to heat energy d an endinto mechanical power. Motor gasoline is often used in the automotive field. Broadly speaking, the gasoline motor is composed by several komPonen major, including the cylinder block*(cylinderblock),*cylinder head*(cylinderhead),*crankshaft (crankshaft), the piston, the piston rod (connecting rod), wheel successor (fly wheel), the shaft cam (camshaft), and the mechanical valve (valve mechanic).

2.3 *Motor Gasoline 2 (Dua) Step*

Motor gasoline is a gasoline engine two-step that only requires one crankshaft rotations to complate the physical in the cylinder. Working (powe is stroke) generated at each putaran shaft the crank motors twostep operate without kat up, instated mostly engine. two-cycleusing a channel in the cylinder wall are opened and closed by the piston as it moves up and down inside the cylinder.

Figure 2. The working principle of the motor fuel picture petrol 2-step; (a) step suction and compression; (b) the power stroke and exhaust.

2.4 Motor Gasoline 4 (Four) step

Motors four steps is a motor that requires twice thecrankshaft rotation to complete one cycle in the cylinder. In other words, each piston-cylinder requires four steps on two crankshaft rotations to complete the cycle.

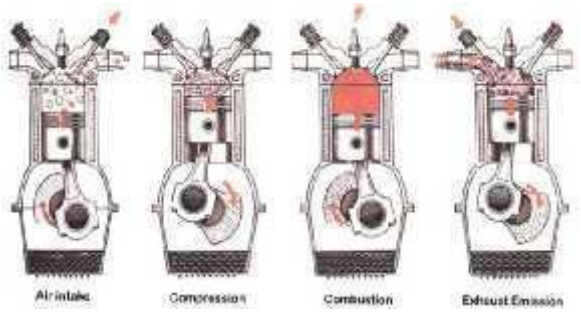

Figure 3. working principle gasoline engine 4-stroke.

A. SuctionStep

Beginning with apiston positions at the top dead point and ending with the position of the piston at the bottom dead point, which suck fresh mixture into the cylinder. To improve the future mix of smoked, intake valve opens shortly before the suction step is started and closed after the end of such a step.

B. The compression stroke

When both valves are closed whereby the mixture inside the cylinder dimanpatkan and its volume is reduced. Towards the end of the compression stroke, the combustion cylinder is turned on and the pressure rises quickly.

*C.*Steppower

Known alsothe expansion step, starting with the position of the piston at top dead point and ends at the bottom dead point when the temperature and high-pressure gas pushing the piston down and force the crankshaft to rotate. When the piston approaches the bottom dead point, the exhaust valve opens to start the process waste and cylinder pressure down near the exhaust pressure.

D. Exhaust step

Where is the rest of the gasis burned out of the cylinder due to cylinder pressures substantially higher than the exhaust pressure. The gas is then pushed out by the piston as it moves toward the top dead point. When the piston approaches top dead point, ketup open input.Shortly after top dead point, the exhaust valve closes and the cycle begins again.

E. The volume of the cylinder

Volume of the cylinder is the large volume of step*(pistondisplacement)*plus the volume of the combustion chamber. Volume step is calculated from the volume above the piston when the position of the piston at the bottom dead point to the top dead point line.While the volume of the combustion chamber is calculated from the volume above the piston when the position of the piston

is at top dead point, or often called residual volume. The large volume of the contents of a step or step piston volume is multiplied byring,

$$V \quad 4 \quad L$$

the length of the piston withequation. :

$$V \qquad V \qquad V$$

While the volume or cylinder expressed by=equation:+

Where ;

VL = Volume of step (cm) or (cc)

L = length of the pistons (cm)

Vt = Volume of total or cylinder (cc) Vs = Volume of residual or volumechambercombustion(cc).

$$r_c \quad \frac{V + V}{V} \qquad r_c \quad \frac{V}{V}$$

1

F. Compression Comparison

Compression ratio is the ratio between the cylinder volume and the volume of the combustion chamber or the compression chamber, which can be expressed by the equuation or =+

Where:

r_c = compression ratio or compression ratio

VL = Volume of step

Vs =Residual volume or volume of the combustion chamber

If the compression ratio of a piston combustion engine is high, it will affect the result of pressure from the combustion process in the cylinder. Therefore, to enhance work efficiency motors can be done by increasing theratio.compression Limits the compression ratio for motor gasoline is lower than in diesel motors. This is due to the gasoline engine when the5-stepcompression that is a mixture of gasoline with compressed air.

G.Working Power Motor

Power motors work or work performance motorcycle is movement or rotation machine that produces work per unit time. The resulting power of the motor can be divided into two, namely power and effective power indication.Power indicator is theoretically motor power, which has not been influenced by mechanical friction losses that occur in the engine. While the effective power or the power of business is useful as a driving power or shaft power. To power the indicator caused by the gas pressure inside the engine cylinder during the combustion process that amount of change.

H. Fuelbesin

Gasolineare liquid fuels derived from petroleum distillation. Where is the most important element ingasoline is the content of hydrogen (H) and carbon (C), or so-called hydrocarbons.Gasoline has chemical compound C_8H_{18} is a mixture of liquid hydrocarbon compounds are highly*volatile*.Gasoline consists of paraffin,naptalene, aromatics, and olefins, together with someorganic compoundsotherand contaminants. Molecular structure consisting of C_4 - C_9 (paraffins, olefins, naptalene, aromatic).Some of the fuel characteristics such hidrikarbonvilotilitas orability to evaporate, octane value and energy content. Characteristics of the octane rating of gasoline is a measure of how resistant to premature explosion*(prematuredetonation)*orknock*(knocking).*Vilotilitas high gasoline evaporates very quickly, while lower gasoline vilotilitas slowly evaporate. Must have good gas vilotilitas the right to a climate where gasoline is used. If gasoline is too modah evaporated in the fuel it will produce a condition known as vapor blockage.

I. Figures Octane

Octane number is a number that indicates the durability of a fuel range of the detonation or *knock.*Octane ratings basedthe measure of the ability of fuel (gasoline) resist detonation. The higher the octane rating, the less likely to produce a burst of early*(pre-ignition)*or ignition*(self-ignition).*Ignition propensity itself cause symptoms knock*(knocking)*associated with the compression ratio of the motor. Motor with low compression ratio can use fuel with lower octane numbers, but high

berkompresi motors must use high-octane fuel to avoid its own ignition or knocking.Two methods were used to measure the octane rating of gasoline is the method of the motor*(motormethod)*by reference to ASTM D-2700 andresearch methods*(researchmethod)*by reference to ASTM D-2699, which is expressed by the octane number of motor(motor*Octan,* MON) and a number of research*(ResearchOctan,* RON). MON and RON value measured by the motor *Cooperative Fuel Research* (CFR), the main reference fuel normal heptane*(n-heptane)*andisooktana.

J. Combustion Chemistry

Basic combustion process can be described by a chemical reaction offuel(hydrocarbon) with pengoksidasinya (air or oxygen) called rektan, which is undergoing a process of chemical process while releasingheat to form a combustion product. In acombustionperfectprocess,known as the stoichiometric combustion, all the carbonin the fuel to form carbon dioxide (CO_2)and a hydrogen to form water (H_2O) in the product. Because each mole of oxygenneeded to oxidize hydrocarbons need to be supplemented with 3.76 moles of nitrogen, it may be written complete combustion of hydrocarbon fuels public of average molecular composition C_xH_y with air as follows:

$C_xH_y + z (O_2 + 3.76 N_2) => a CO_2 H + b_2O + cN_2 + dO_2$ (1)

where z is referred to as the stoichiometric coefficients for the oxidant (air).

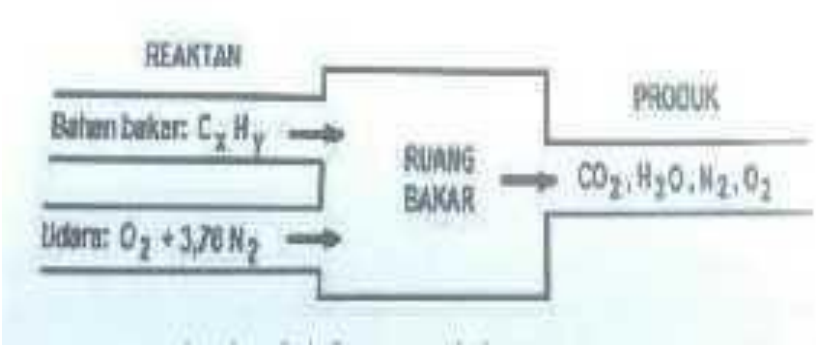

Figure 4. perfect combustion process.

The reaction equation produces five unknown variables, namely z, a, b, c, d, and so we need to solve the five equations balance the number of atoms of each element in the reactants (carbon, hydrogen, oxygen, and nitrogen) and products. In stoichiometric combustion, assuming no excess oxygen in the product so that d = 0. The water formed in the product can be in the vapor phase or liquid, depending on the temperature and pressure of combustion products.

3. Research Methodology

3.1 Research type

Type of comparative research is a premium fuel and pertalite with modified *cylinder head* to determine the torque and power in one cylinder motorcycle vehicle types Honda Beat 110 CC in 2012.

3.2 *Materials and Devices Research*

The materials used in this study is :

a. Premiumfuel
b. Fuelpertalite
c. *cylinder head* which has been inmodification.

Supporting tools used in this research are:

1. Motorcycles Honda Beat 110cc in 2012.
2. Computer.
3. Stopwatch.
4. Dynamometer.

3.3 ImplementationTesting

Processtesting and sampling data on power and torque do the following steps:

1. Prepare the measuring instrument to be used.
2. Use *cylinder head*standardfirst.

3. Filling the tank of premium fuel in the vehicle, checking carburizing system, and ignition must be ensured under normal conditions and standards.
4. Pressing the channel *ignition switch* to "ON".
5. Menhidupkan machine by means of *kickstarter*. engine
6. Once the engine, set therev the engine to set *throttle* up a stationary condition and then left for 3 to 5 minutes to warm up.
7. Once the engine is hot, then the vehicle is raised to dynotest.
8. Adjusting accordance with the desired rotation.
9. At the same time, do the reading and recording data power and torque generated.
10. Repeat step 9 with a different rotation.
11. When finished, operate the control *throttle* to the position, *idle* then the engine is off.
12. Repeat steps 3 through 11 by replacing the *cylinderhead* standard with the *cylinder head* has been modified.
13. Repeat steps 3 through 11 by replacing premium fuel with pertalite.

3.4 Compression Ratio ChangesModification Effect Cylinder Head

Modification method or increase the compression ratio used is by trimming *cylinderhead* with thickness trimmingof 0.5 mm. With these methods

$$VL = \frac{\pi}{4} \cdot d^2 \cdot L_1$$

$$= \frac{3,1}{4} \cdot \left(\frac{5}{1} c \right)^2 \cdot \left(\frac{5}{1} c \right)$$

$$= 107,9 \text{ cm}^3 = 108 \text{ cm}^3 = 108 \quad (2)$$

= 107.9 ___cm^3 = 108 cm^3 = 108 CC.

Where:

d = diameter piston

L_1 step= length of the piston

combustion chamber volume reduction due to volume of thechamber combustion is generated after the modification *of the cylinder head* pruning:

$$Vs_1 = \frac{V}{(r_c - 1)}$$

$$= \frac{1 \quad c}{(9,2 - 1)}$$

$$= 13,17 \text{ CC} \quad (3)$$

$Vs_m = Vs_1 - Vs_2$

= 13.17 CC - CC0.98

= 12.19CC.

Then change the compression ratio produced are:

$$r_c = \frac{+}{-V \quad C + 1 \quad C}$$

$$8, \quad 1 \quad 1 \quad C$$

=

= 9.8. (4)

So after the modification throughpruning*the cylinder head*method,increasing the compression ratio from 9.2: 1 to 9.8: 1.

2 Testing results and Discussion

Data obtained from the results of testing in*workshop* southern JakartaAerospeedusingengine, *dynotest*the results obtained from this test is a chart that appears in the computer automatically, the results of the data in the form of Torque (ft-lbs) and Power (HP). In this study, using a type of Honda Beat motorcycle 110cc in 2012 with premium fuel and pertalite, as well as the effect of compression ratio on the performance of the motorcycle.The data obtained from the test results were as follows:

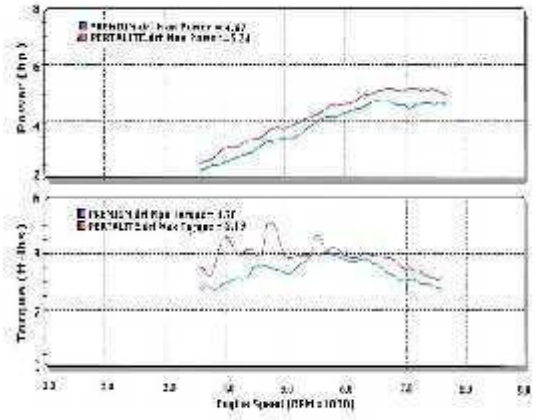

Figure 5. The test results using *cylinder* a standardh and *cylinder* a modifiedhead.

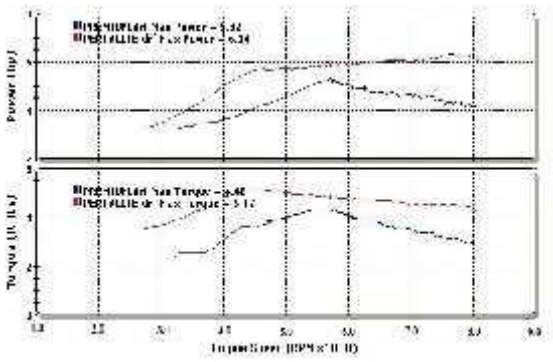

Figure 6. The test results using

Table1. Maximum power test results.

#	Material Fuel	*Cylinder Head* Standard (HP)	Modifikasi (HP)
1	Premium	4.67	5.32
2	Pertalite	5.24	6.34

Table 2. maximum torque testing results.

No.	Material Fuel	*Cylinder Head* Standard (Nm)	Modifications (Nm)
1	Premium	6.37	5.97
2	Pertalite	7.04	7.01

When using *cylinder* a standardhead,the difference between the maximum power and torquepremium fuels and pertalite very clearly visible.atpremium fuelmaximum power obtained at 4.67 HP at rotation of 6500 rpm and maximum torque of 6.37 Nm at 4500 rpm rotation, whereas in pertalite obtained power of 5.19 HP at 4700 rpm rotation and a maximum torque of 7.04 Nm at 6750 rpm rotation. Likewise, when using *cylinder* a modifiedhead,the difference between the maximum power and torque premium fuels and pertalite very clearly visible. Premium fuel at maximum power gained by 5.32 HP and a maximum torque of 5.97 Nm, while the pertalite obtained power of 6.34 HP and a torque of 7.01 Nm.After breathing or modifications to the *cylinder head* which led toan increaseincompression ratio, a positive impact on both the motor power when using premium fuel and pertalite. The results show the increase in power of 4.67 HP to 5.32 HP when using premium fuel. And so also with pertalite which shows an increase of 5.24 HP to 6.34 HP. However, things are different from the test results indicated torque, which, on premium fuel decreased from 6.37 Nm to 5.97 Nm. As for pertalite again decreased from 7.04 Nm to 7.01 Nm.

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